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ed : Which being a case so very odd, and never (that I have ever met with) taken notice of before, I have thought it a part of my Duty I owe to this ingenious and learned Society, to acquaint you with it ; hoping it may give some lucky hint to some Ingenious Person, for the better discovery of that intricate Subject, concerning the Nature of Magnetick Bodies.

VII. *Farther Observations and Remarks on the same Subject.*

I Lately gave the Society an account of the *Destruction of the Magnetick Virtue* in a touched piece of Iron Wire, by *Bending, or Coyling round* : Which I thought had been a Novelty. But by looking over more accurately what others have written of Magneticks, I find in *Grimaldi de Lumine and Colore*, that he, and in our *Phil. Transactions*, N. 188, that *Mr de la Hire* had hit upon the same discovery before me. However, they having not prosecuted their Discovery so far as I did, and my account containing divers things not taken notice of by them, I hope what I sent the Society was not unacceptable.

And indeed it is very happy for me that I have the Authority of so Ingenious Persons on my side, because the Experiment not succeeding in some tryals since, I have had reason to fear lest the Society might call my Integrity in question.

The matter of fact was thus, and to me surprizing : I touched and coyled several Iron Wires, but the effect that ensued was not such as I told the Society. The Verticity was indeed much weakened, but not totally destroyed, and the ends of the Wires would be attracted or repelled by

by the Poles of the Magnet ; whereas I said they used only to be attracted. The next morning I tryed again : And then the Magnetism of the Wires was totally destroyed, as I related to the Society. This Experiment I repeated divers times, and on divers Wires this Winter, and commonly find, that, all the day, coyling will evacuate the Magnetism : But that it will not absolutely do it in the Evenings. But whether it will do so in Summer, or all Weathers, or whether it succeedeth thus only in different times of the Day, I must leave to farther Tryals. I well know that the Orb of the Activity of Magnets, is larger, or less, at different times. That noble Magnet in the Society's Repository found in *Devonshire* by Dr Cotton, is known in some Weathers (or at some times) to keep a Key, or other piece of Iron, suspended to another Iron at 8, 9 or 10 foot distance. But at other times, the Iron will drop down at the distance of 3 or 4 foot from the Magnet. If I lived nearer, I would observe the *Phenomenon* more nicely : Particularly whether there be any difference therein in the Evening, and the rest of the Day. Now whether at all, or how far this may reach the forementioned case, I cannot say, not having as yet sufficiently experimented the matter.

Finding the case thus with *Coyled*, or *Bent Wire*, I was minded to try the event of *Twisting* of Iron Wire from end to end, after it had been well Touched. The Success was, The *Verticity* was always weakened, and sometimes inverted. And when it was so, the Loadstone did accordingly commonly Repel or Attract, all one as if the Twisting the Wire had given a new Touch the contrary way.

But in some Wires so twisted, the *Verticity* was wholly destroyed, or rather much confused. For I found by drawing one of the Poles of the Loadstone along near the sides of the Wire, that in some places it would Attract, in others Repel, and so attract and repel all along the Wire. Nay,

I fancied in some places, that one side of the Wire would be attracted, the other repelled by one and the same Pole of the Loadstone.

To these odd changes, I could add divers others, which the *Twisting* produced. But these do sufficiently shew that the Magnetick Virtue is put into great confusion by the Violence exerted upon the Wire by *Twisting*: Which not only separateth the fibres of the Iron (as may be seen with the Eye, especially assisted with a Microscope) but also changeth their Situation from Longways to Skrew-ways.

This being the Success of *Twisting*, I was next minded to try what would be the issue of *Splitting* or *Cleaving* touched Wires: Particularly whether they would exert the same effects that Magnets are said to do, when sawn in two Meridionally. Concerning which Dr *Ridley* saith, "Cut a piece from a Magnet stone Meridionally, and that end which was placed S. when it was whole, being severed, will turn North, although naturally at first it was the S. point. But Mr *Barlow* (who seems to have been a more judicious and faithful Author, is of a contrary mind, and saith, That the Poles of such a piece of Magnet, when severed, will abhor the same Poles, to which it grew in the whole Magnet. But he subjoyns, "But here you must beware of an error, which some unhappily have entangled themselves withal, who beholding the aforementioned discord, wrongfully supposed, that if both these Magnets the greater and the less [*i. e.* the piece cut off] were conveniently placed to swim in Water, the little one would not with his end point unto the South of the Earth as it did in the Magnet being entire, when it was a part of the true North-end, but would point contrarily. There is (saith he) no manner of any such alteration, but that both the great one, the little one, (and all the like, that are cut Meridionally one from another) will absolutely point the very same way which the entire one did. Only the Meridian will be somewhat removed, &c.

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Dr Gilbert (whose Judgment and Fidelity is not to be questioned) is as express as his Friend Mr Barlow. For (L. 2. c. 5.) speaking of a Magnet divided, and shewing how that the parts which in the whole Stone coalesced, do by Separation repel one another, he saith, *That what was the N. and S. Pole before, is such still. Non enim (saith he) immutatur Verticitas (quod malè affirmat B. Porta.) Nam licet [Poli separati] non conveniunt, ut alter ad alterum inclinet; tamen uterque in idem horizontis punctum converuntur.*

How the Truth lieth between Dr Ridley and the two later Authors I cannot determine, having never so cut a Magnet. But by the Magnetick Laws, as well as from the Authority of Dr Gilbert and Mr Barlow, I doubt not but the later is the truest opinion.

But in *Cleft Wires* the case is very uncouth. Oftentimes the Poles are quite changed: So that what was the *North*, becometh the *South* Pole of the Wire in all respects; I mean, not only turning, but also embracing, or avoiding the Poles of the Loadstone, as if it had received a new, and contrary Touch. Sometimes one half of the Wire will retain its Magnetism, which it had before splitting, and the other half have it quite changed. Sometimes no change at all will ensue, only the Magnetism be much weakened; as indeed it always is in all the Experiments where the Wire is split. (But generally, where one of the halves hath suffered change, the other not, I have observed, That 'tis the thinnest and weakest that hath been changed, and the thickest hath retained its Touch.) Sometimes where one of the Split Halves receiveth an *inverted Verticity*, or seemeth to have no Verticity at all, one of its Ends will incline to one of the Poles of the Magnet, not according to its Touch, but in an inverted order, and the other end be attracted indifferently by both the Poles of the Loadstone. And in some cases, that End shall be attracted by one Pole,

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but be neither attracted nor repelled by the other; but stand as it were hesitating whether it had best fly to, or from that Pole of the Loadstone. Only if that Pole of the Magnet be too near, then that end of the Wire will constantly fly thereto: As indeed it is the nature of all Magnets and Magnetick Bodies to do, when they touch, or approach very near one another, tho they repelled before.

The Cause of these great Changes in touched Wire produced by *Splitting*, I have sometimes imagined to arise from the Violence exerted thereon by Bending. But in some Wires that I split, or cleft with very little bending, one Half hath been utterly changed, the other not. In others that I cleft, by suffering the Halves to bend as much as they would, no change hath been; and some have quite suffered change.

Sometimes I have imagined that the Splitting the Wires in a N. or S. position, or that the beginning to split at the N. or S. end of the Wire first, might be the cause of this contravention of the Poles. But tryals shewed there was little in any of this.

Thus I would have done with *Split or Cleft Wires*; but there is one thing very surprizing, which will deserve to be mentioned, *viz. That the laying one, or the other side of the Half uppermost*, will cause a great alteration in its Tendency, or Aversion to the Poles of the Magnet (as I have said.) But if you lay the contrary side of that Half uppermost, the same End shall be attracted by one, and repelled by the other Pole of the Magnet. In other pieces, where the Ends are regularly attracted or repelled, only in an inverted order (as if new touched,) if it lay with the round side uppermost at that time, and be then turned upside down, *viz. the flat cleft side uppermost*, 'tis ten to one if one of the Ends be not either attracted by both the Poles, or repelled by both; or else attracted or repelled by one, and hesitates as to the other: For so it often befalls.

The Cause of this lubricity of the Magnetism, I imagined might be, because the sides or edges of the Wire had received contrary Poles by Splitting: And consequently were turned topsy-turvy, that what was the N. might then be the S. edge of the Half. But I could never discover, but that the sides of each end, or of any other part, were the same, when I held the Loadstone to one or the other side. Which indeed I always did in every Experiment for greater certainty sake.

My Hand being thus in, I was minded to repeat the old Experiment of Touching Wires, *by rubbing them backwards and forwards* with one of the Poles of the Loadstone, because it might probably give some Light into the aforementioned strange *Phænomena*.

Mr Barlow was I think the first (at least he saith he was) that discovered the error of this way of Touching, *viz.* That it weakeneth or much hurteth the Touch. This I tryed, and found what is said, not only to be true, but also that the Reason thereof is, *Because the Poles of the Wire, or Needle, so touched, are not at the Ends, but in, or near the Middle of the Wire or Needle.* Sometimes one is near the Center, the other at one or both Ends. For in some Wires so touched, both the Ends of the Wire would be Attracted by one Pole of the Loadstone, and Repelled by the other. And in such case the Repelling Pole always found a Sympathetick part near the Center of the Wire. In others (especially where a Verticity succeeded, as sometimes it will do, and that pretty strongly too, in such a case) the Verticity would be inverted, and the Ends of the Wire be attracted and repelled in a direct contrary manner to the Natural Form. And the Reason of all this will be manifest from these following Experiments.

I touched a Wire from end to end with only one Pole of the Magnet. This gave so vigorous a Touch, that I am almost of opinion, *It is the best way of Touching.* The Consequence was, The End where I began always turned

contrary to the Pole that touched it. I again touched the same Wire, and others too with the other Pole of the Magnet, from the same end, and then that end turned the contrary way. E. G. Mark one end of a Wire for the North-end, and Touch that Wire, by drawing the N. Pole of the Magnet divers times along the Wire from the N. to the S. end : This Wire so touched shall have a vigorous Verticity ; but the North-end shall stand South. But if you touch that or another Wire, (for it is all one, because the Latter destroys the Former Touch ; I say, if you Touch) by drawing the N-Pole of the Magnet from the S. the N-end of the Wire, then this N-end will turn N. And so it will do the same, if you Touch with the Southern Pole from the N. to the S.

Lastly, There is one Experiment more doth yet give farther light into what goeth before, *viz.* I touched an Iron Wire exactly in the middle with only one Pole of the Loadstone, without drawing it backwards or forwards. The Event was, That in that place that Pole of the Wire was, and the two Ends were the contrary Pole of the Wire ; and were accordingly Repelled or Attracted by the Poles of the Loadstone : And the Middle, and an inch or more on each side was attracted by the Pole only that Touched it.

And now, if we reflect upon what hath been said, and compare the foregoing Experiments one with another, they not only illustrate one another, but seem to lay open a fair way towards the discovery of a great many of the intricate *Phænomena* of Magneticks. And therefore, besides the Novelty, their Usefulness may, I hope, render these Experiments and Observations acceptable to this Illustrious Society.